इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”
Mazdoor Kisan Shakti Sangathan
“The Right to Information, The Right to Live”

“पुराने को छोड नये के तरफ”
Jawaharlal Nehru
“Step Out From the Old to the New”

IS 2742-4 (1994): Automotive vehicles - Brake linings, Part 4: Co-efficient of friction - Method of test [TED 4: Automotive Braking Systems]

“ज्ञान से एक नये भारत का निर्माण”
Satyanarayan Gangaram Pitroda
“Invent a New India Using Knowledge”

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”
Bhartṛhari—Nītiśatakam
“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA JURIS NON EXCUSAT

PROTECTED BY COPYRIGHT

IS 2742 (Part 4) : 1994
(Reaffirmed 2004)

भारतीय मानक

स्वचल वाहन — ब्रेक आस्तर

भाग 4 घर्षण गुणांक — परीक्षण पद्धति

Indian Standard

AUTOMOTIVE VEHICLES — BRAKE LININGS

PART 4 COEFFICIENT OF FRICTION — METHOD OF TEST

UDC 629·113-597·6 : 620·16

© BIS 1994

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

November 1994 Price Group 5

Automotive Braking Systems Sectional Committee, TED 4

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Automotive Braking Systems Sectional Committee had been approved by the Transport Engineering Division Council.

Friction materials used for brake linings play an important role in the overall efficiency of braking systems. The general method for assessment of friction properties is to carry out a bench test on a sample of brake linings. The performance data obtained can be used for effective quality control by friction material manufacturers as well as for easy assessment by the purchasers.

The purpose of this standard is to establish a uniform laboratory procedure for securing and reporting the friction and wear characteristics of brake linings. The performance data obtained can be used for in-plant quality control by brake lining manufacturers and for the quality assessment by the purchasers of brake linings.

This (Part 4) is one of the many parts of IS 2742 series of standards on brake linings and their test methods. The other parts are:

2742 (Part 1) : 1994	Automotive vehicles — Brake linings (non rubberised) : Part 1 Specification (*first revision*)
2742 (Part 2) : 1994	Automotive vehicles — Brake linings (rubberised) : Part 2 Specification
2742 (Part 3) : 1994	Automotive vehicles — Brake linings : Part 3 Methods of test
2742 (Part 5) : 1994	Automotive vehicles — Brake linings : Part 5 Internal shear strength — Method of test

In the preparation of this standard considerable assistance has been derived from:

ISO 7881 : 1987	Brake linings — Evaluation of friction material characteristics — Small sample bench test procedure
BSAU 142-1968	Methods of test for brake lining materials
SAE J-661	Brake linings quality control test procedure
SAE J-866	Friction coefficient identification system for brake linings

The committee responsible for the preparation of this standard is given in Annex C.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

Indian Standard

AUTOMOTIVE VEHICLES — BRAKE LININGS

PART 4 COEFFICIENT OF FRICTION — METHOD OF TEST

1 SCOPE

This standard specifies the method of evaluation of friction coefficient of brake linings by a friction material test machine (popularly known as 'Chase' machine).

2 REFERENCES

The following Indian Standards are necessary adjuncts to this standard:

IS No.	*Title*
2742 (Part 1) : 1994	Automotive vehicles — Brake linings (non rubberised) : Part 1 Specification (*first revision*)
2742 (Part 2) : 1994	Automotive vehicles — Brake linings (rubberised) : Part 2 Specification
2742 (Part 3) : 1994	Automotive vehicles — Brake linings : Part 3 Methods of test
3178 : 1965	Abrasive emery grain

3 TERMINOLOGY

For the purpose of this standard, the following definitions shall apply.

3.1 Normal Friction Coefficient

It is defined as the average of four points on the second fade curve, located at 93°C, 121°C, 149°C and 205°C.

3.2 Hot Friction Coefficient

It is defined as the average of 10 points located at 205°C and 149°C on the first recovery; 233°C, 261°C, 289°C, 317°C and 345°C on the second fade; and 261°C, 205°C and 149°C on the second recovery.

NOTE — If any temperature point or points required for calculating friction coefficient are not reached in the prescribed time limit, the coefficient of friction value at ten minutes shall be used to give the full number of points required.

4 TEST EQUIPMENT

A typical friction materials test machine used is shown in Fig. 1. The friction materials test machine shall be equipped with suitable means for:

1) Measuring the drum temperature.
2) Heating the drum.
3) Controlling the drum heating rate.
4) Cooling the drum from the rear side only.
5) Controlling the drum cooling rate.
6) Measuring friction force (135 kg *Max*).
7) Measuring drum rotational speed (150 to 1 000 rev/min).

4.1 Accuracy of Measurement

a) The temperature measuring system shall have ± 2% full scale accuracy.
b) The friction force measuring system shall have ± 2% full scale accuracy.
c) The drum speed measuring system shall have ± 2% full scale accuracy.

4.1.1 The drum used shall have inside diameter limits between 277 and 280 mm and shall have provision for locating three thermocouples, one each at depths of 2·55 (stamped number 1), 3·05 (stamped number 2) and 3·55 mm (stamped number 3) from the new drum surface diameter of 277 mm. The thermocouple for temperature measurement shall be mounted in the position indicated (*see* Fig. 2):

Drum Inside Diameter	*Location Marking on Drum*
277-280	1
278-279	2
279-280	3

5 TEST CONDITIONS

5.1 Actual tests for performance shall be started when preparations have been completed in accordance with **6**.

a) Means shall be provided for measuring specimen thickness and mass.
b) The temperature measuring means shall incorporate a welded thermocouple, coin silver slip rings, silver graphite brushes and an indicator and/or recorder having a high input impedance.
c) The drum heating means shall be adjusted as follows and remain so during test. With the drum rotating at 411 rev/min, cool from 149°C to 93°C with cooling air on. Then cool to 82°C with cooling air off. Turn on heaters at 82°C and start timer. Heat for 10 minutes. Drum temperature shall be 221°C ± 14°C at 10 minutes.

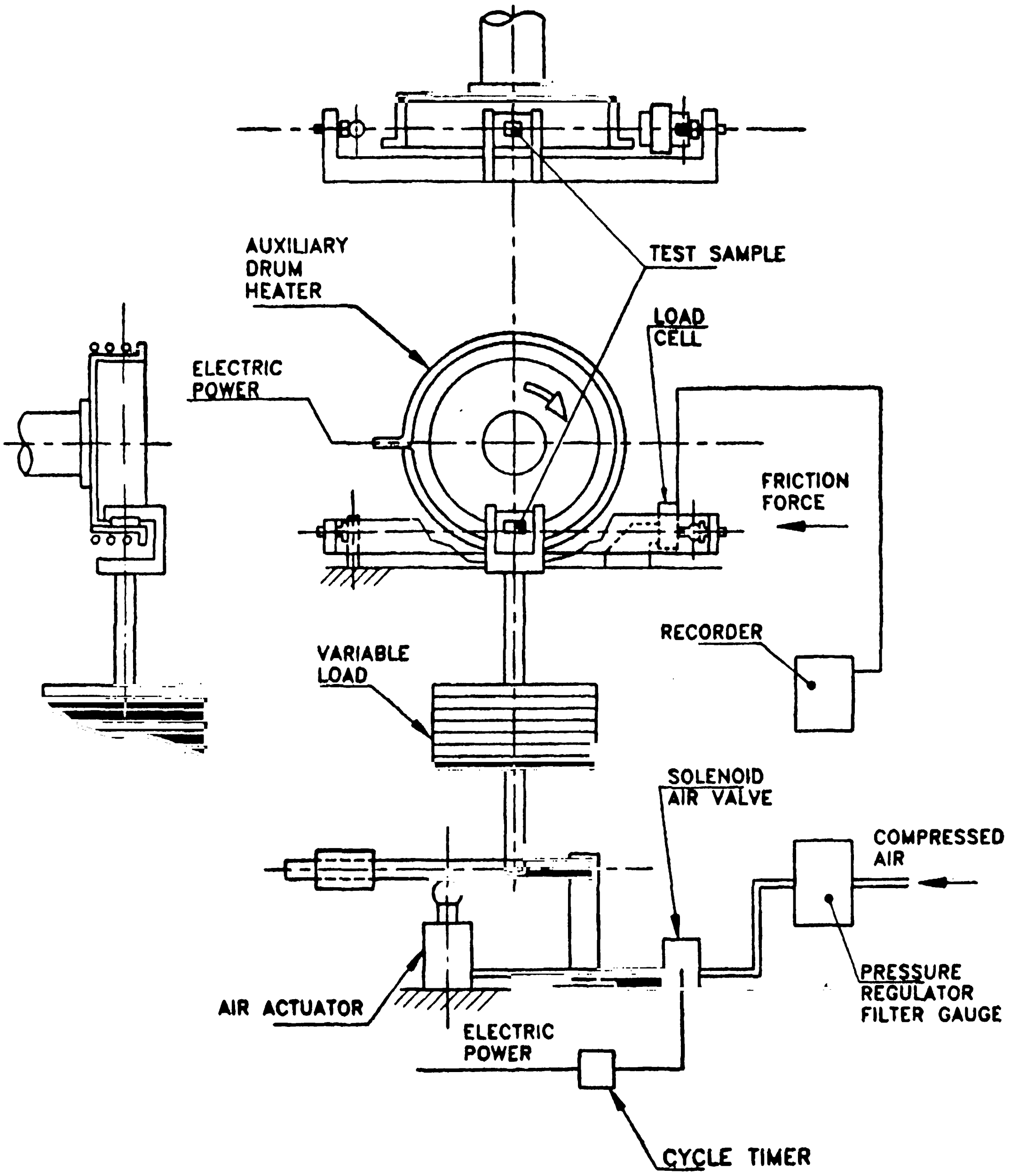


FIG. 1 TYPICAL FRICTION MATERIAL TEST MACHINE

d) The drum cooling means shall be adjusted as follows with the drum rotating in 411 rev/min, and after having heated the drum with the heater elements to 371°C turn off heaters and turn on cooling air. Cool to 345°C and start timer. Cool for 10 minutes. Drum temperature shall be 93°C ± 14°C at 10 minutes.

5.2 Conduct of Test

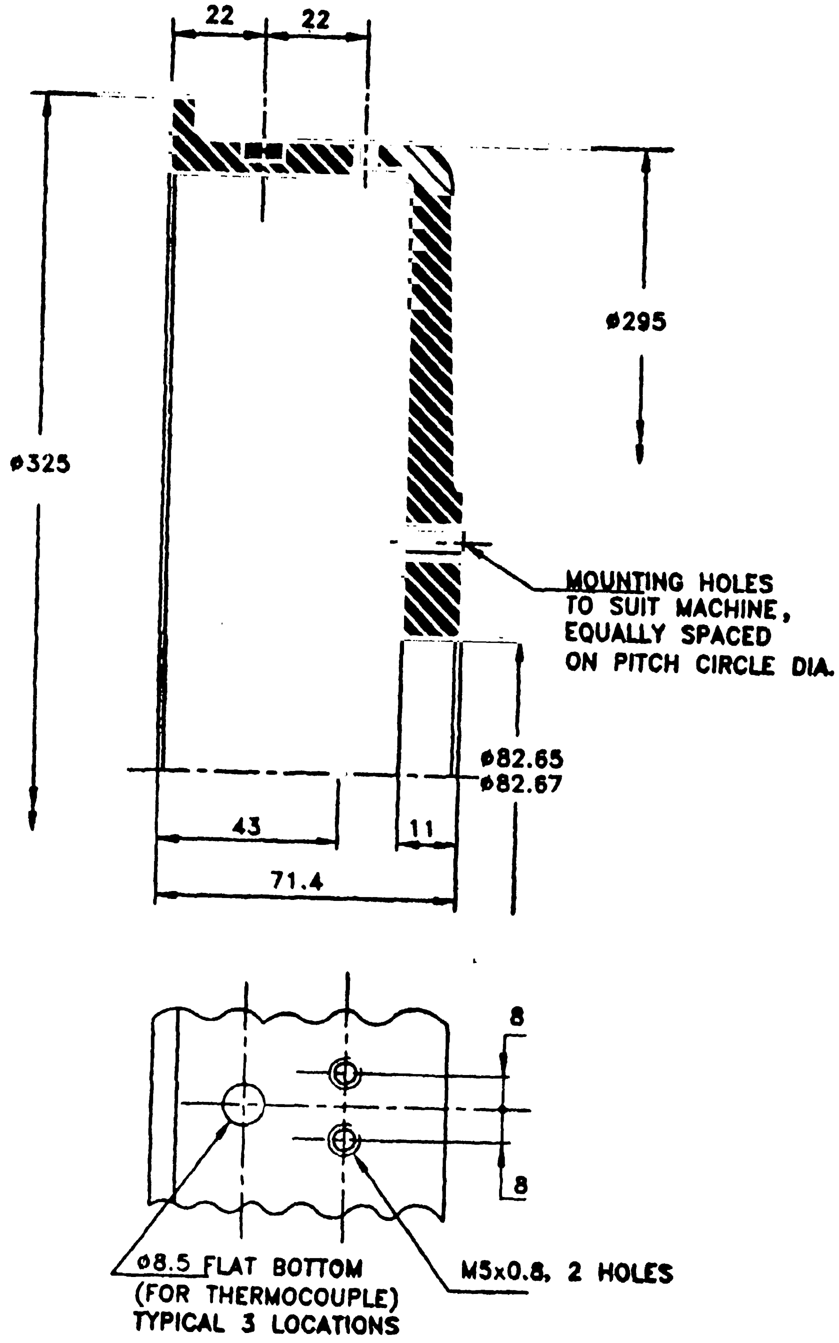
All testing shall proceed without any interruption.

6 TEST PROCEDURE

6.1 Preparation of Test Specimen

The test specimen shall be taken from the centre of the friction material approximately equidistant from each end.

The specimen shall be 25 × 25 mm square (625 mm^2) flat on the bottom, and the radius of the working surface shall conform to the radius of the test drum. Where width of the lining is less an those specified, actual thickness of lining all be considered. On pre-ground linings, move at least 0·3 mm but not more than 0·5 mm om the working surface of the specimen. For n-ground linings (directly from moulds) remove 0/1·2 mm to be certain that the resin impregnad surface is totally removed. Specimen thickness or specimen plus shim) should be approximaly 6 mm measured in the centre of the specimen. Excess of material shall be removed from the side opposite the working surface of the specimen. In cases, where nominal lining thickness is less than 5 mm, remove minimum amount of material from the side opposite to the working surface to produce flatness. The working surface of the specimen shall not be handled and shall be kept free from foreign material.


22
22
ø295
ø325
MOUNTING HOLES TO SUIT MACHINE, EQUALLY SPACED ON PITCH CIRCLE DIA.
ø82.65
ø82.67
43
11
71.4
8
8
ø8.5 FLAT BOTTOM (FOR THERMOCOUPLE) TYPICAL 3 LOCATIONS
M5x0.8, 2 HOLES

All dimensions in millimetres.

FIG. 2 TYPICAL FRICTION MATERIAL TEST MACHINE DRUM

6.2 Preparation of Test Drum Surface

6.2.1 *New or Resurfaced Drum*

After grinding the drum surface of the test machine, remove all grinding marks by polishing with abrasive paper or cloth. Final polishing shall be with 320 girt as specified in IS 3178 : 1965. Remove dust from drum with clean dry cheese cloth, white paper towelling or any equivalent material. Complete the surface preparation by running a reference specimen continuously at 440 N, 411 rev/min and not over 93°C until the friction coefficient has stabilized.

6.2.2 Before commencement of each test, polish the drum surface with abrasive paper or cloth. Final polishing shall be with 320 girt. Remove dust from the drum with clean cheese cloth, white paper towelling, or any equivalent material.

6.3 Conditioning of Test Specimen

The specimen shall be burnished at 308 rev/min, 440 N and at a maximum temperature of 93°C, for a minimum duration of 20 minutes, to obtain at least 95 percent contact.

6.4 Initial Thickness and Mass Measurements

Specimen thickness shall be measured at three places along the axis parallel to the drum axis (open, centre and closed edges) and recorded. Weigh to nearest milligram and record. Reseat specimen by running continuously for 5 minutes at 220 N and 205 rev/min. Initial clearance between specimen and drum shall be 0·3 to 0·4 mm in the "OFF" position.

6.5 Initial Wear Measurement

With drum stationary and its temperature varying between 88°C and 99°C and with 660 N on specimen, obtain indicator reading of height of specimen holder and record.

7 TEST RUNS

7.1 Baseline Run

Run 10 seconds "ON" (load applied) and 20 seconds "OFF" (load removed) at 660 N and 411 rev/min for 20 applications.

Start run at a drum temperature between 82°C and 93°C and maintain the maximum and minimum temperature during each successive application between 104°C and 82°C with the use of cooling air. Turn cooling air off, on 20th load application.

7.2 First Fade Run

Allow drum to cool by rotation only and with heating and cooling means turned off. At 82°C apply specimen and energize heating elements. Run continuous drag at 660 N and 411 rev/min. Run for either 10 minutes or until 289°C is attained, whichever occurs first. Take readings of friction force at 93°C, 121°C, 149°C, 177°C, 205°C 233°C, 261°C, 289°C. Record time required to reach 289°C.

7.3 First Recovery Run

Immediately following completion of first fade run turn off heater and turn on cooling means and make a 10 seconds application at 660 N and 411 rev/min at 261°C, 205°C, 149°C and 93°C during cooling.

7.4 Second Wear Measurement

Repeat initial wear measurement (*see* **6.5**).

7.5 Wear Run

Run 20 seconds "ON", 10 seconds "OFF", at 660 N and 411 rev/min for 100 applications. Start run at a drum temperature between 193°C and 205°C and maintain maximum and minimum temperatures during each application between 193°C and 216°C with use of cooling air.

7.6 Third Wear Measurement

Immediately upon completion of wear run (*see* **7.5**), cool to a temperature between 88°C and 99°C and repeat initial wear measurement (*see* **6.5**).

7.7 Second Fade Run

Upon completion of third wear measurement, allow drum to cool with drum in rotation and heating and cooling means turned off. At 82°C apply specimen loading and energize heating elements. Run continuous drag at 660 N and 411 rev/min. Run for either 10 minutes or until 345°C is attained, whichever occurs first. Take readings of friction force at intervals of 28°C, starting at 93°C. Record time required to reach 345°C.

7.8 Second Recovery Run

Immediately upon completion of second fade run (*see* **7.7**), turn off heater and turn on cooling means and make a 10 seconds application at 660 N and 411 rev/min at 317°C, 261°C, 205°C, 149°C, 93°C during cooling.

7.9 Baseline Run

Repeat baseline run (*see* **7.1**).

7.10 Final Wear Measurement

Repeat initial wear measurement (*see* **6.5**).

7.11 Final Thickness and Mass Measurement

Measure and weigh as per **6.4**.

8 SELECTION OF PLOT POINT FOR FRICTION COEFFICIENT VALUE

During intermittent application runs, the friction coefficient values shall be taken at the end of the application.

9 PRESENTATION OF TEST DATA

9.1 Data shall be presented on Master Form Log Sheet given in Annex A.

9.2 Data shall be plotted on Master Form Plot Sheet given in Annex B.

ANNEX A

(*Clause* 9.1)

MASTER FORM LOG SHEET

MATERIAL ____________________

LOT ____________________

REFERENCE ____________________

JOB NO. ____________

TEST NO. ____________

DATE ____________

OPERATOR ____________

	MASS	THICKNESS	INDICATOR READING
Initial			
Final			
Loss			

FIRST BASELINE

Appl No.	*Friction Force* N	*FC**
1		
5		
10		
15		
20		

FIRST FADE

Temp °C	*Friction Force* N	*FC**
93		
121		
149		
177		
205		
233		
261		
289		

Minimum at 289°C ________ μ at 10 min

INDICATOR READING

____

WEAR TEST

Appl No.	*Friction Force* N	*FC**
1		
10		
20		
30		
40		
50		
60		
70		
80		
90		
100		

SECOND FADE

Temp °C	*Friction Force* N	*FC**
93		
121		
149		
177		
205		
233		
261		
289		
317		
345		

Minimum at 345°C ________ μ at 10 min

SECOND RECOVERY

Temp °C	*Friction Force* N	*FC**
317		
261		
205		
149		
93		

---

*FC — Friction coefficient, μ.

ANNEX A (*Concluded*)

FIRST RECOVERY

Temp °C	*Friction Force* N	*FC**
261		
205		
149		
93		

INDICATOR READING

SECOND BASE LINE

Appl No.	*Friction Force* N	*FC**
1		
5		
10		
15		
20		

REMARKS ______________________________

____

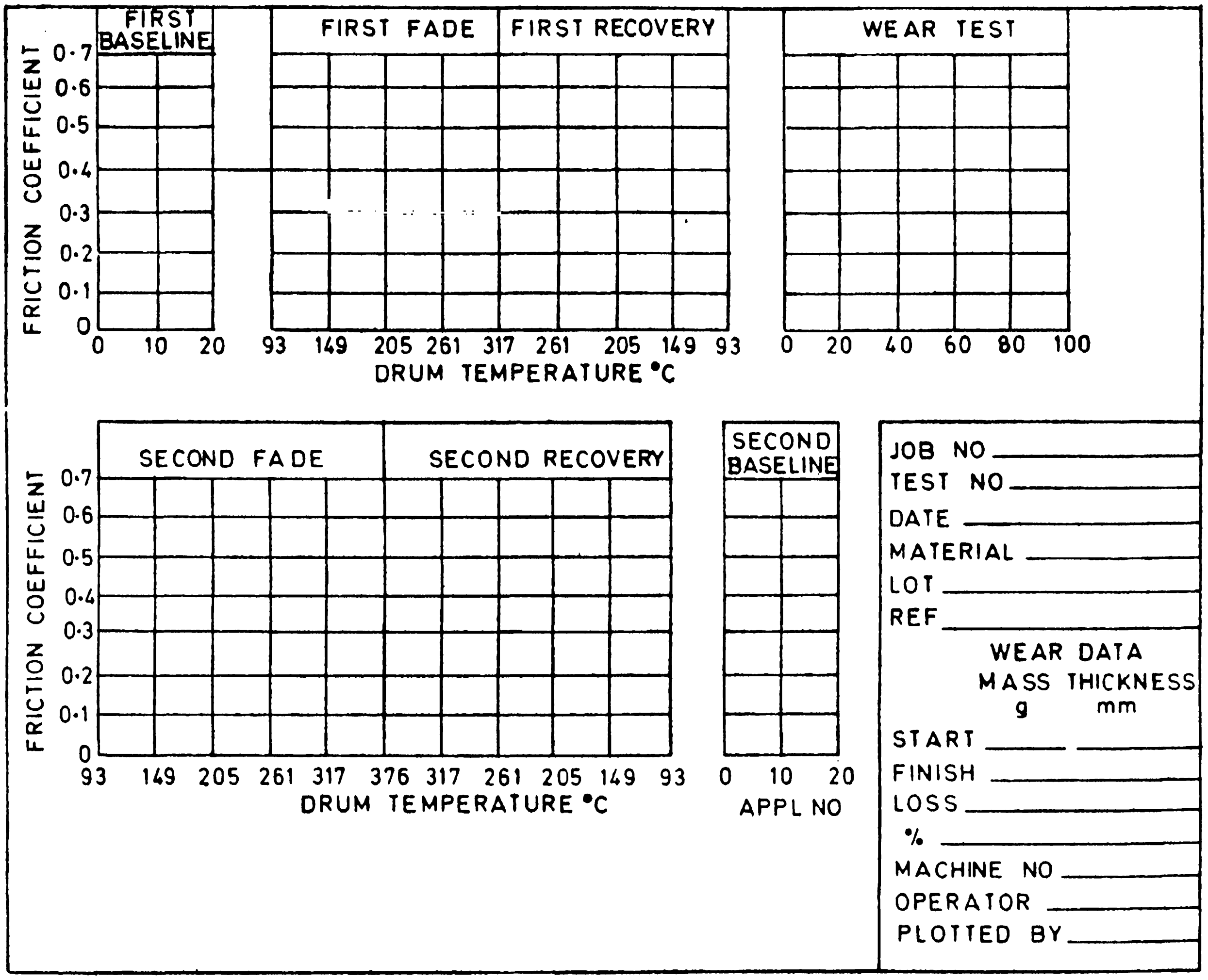
---

*FC = Friction coefficient, μ.

ANNEX B

MASTER FORM PLOT SHEET

(*Clause* 9.2)



JOB NO ____________
TEST NO ____________
DATE ____________
MATERIAL ____________
LOT ____________
REF ____________

WEAR DATA

	MASS g	THICKNESS mm
START		
FINISH		
LOSS		
%		

MACHINE NO ____________
OPERATOR ____________
PLOTTED BY ____________

ANNEX C

(*Foreword*)

COMMITTEE COMPOSITION

Composition of Automotive Braking Systems Sectional Committee, TED 4

Chairman	*Representing*
Shri R. Ramakrishnan	Ashok Leyland Ltd, Madras
Members	
Shri P. Nageshwar Rao (*Alternate* to Shri R. Ramakrishnan)	
Shri H. K. Acharya Shri Y. V. Nagaraj (*Alternate*)	Enfield India Ltd, Madras
Shri T. M. Balaraman Shri C. Y. Deshpande (*Alternate*)	Bajaj Auto Ltd, Pune
Shri B. K. Ghosh Shri S. P. Tiwari (*Alternate*)	Tata Engineering and Locomotive Co Ltd, Pune
Shri K. C. Jain Shri R. K. Gupta (*Alternate*)	Escorts Ltd (MSD), Faridabad
Shri A. K. Jindal	Swaraj Mazda Ltd, Chandigarh
Shri P. D. Joshi Shri C. M. Mehta (*Alternate*)	Scooters India Ltd, Lucknow
Shri I. G. Kandaraji Shri Alok Nigam (*Alternate*)	HMT Ltd (Tractor Division), Pinjore
Shri J. S. Khadilkar Shri S. S. Patil (*Alternate*)	Kalyani Brakes Ltd, Pune
Shri S. S. Khosla Shri A. P. Singh (*Alternate*)	DGTD, New Delhi
Shri V. R. Marathe Shri P. V. Bhandre (*Alternate*)	Kinetic Engineering Ltd, Pune
Lt Col A. K. Mehrotra Major K. R. Singh (*Alternate*)	Controllerate of Quality Assurance (Vehicles), Ahmednagar
Shri O. P. Middha Shri Habib Rahmathulla (*Alternate*)	Allied Nippon Ltd, Sahibabad
Shri M. K. Mishra Shri B. L. Pathariya (*Alternate*)	Vehicles Factory, Jabalpur
Shri Z. A. Mujawar Shri P. N. Rangan (*Alternate*)	Automotive Research Association of India, Pune
Shri V. M. Mundada Shri C. S. Maikhuri (*Alternate*)	Bajaj Tempo Ltd, Pune
Shri M. N. Muralikrishna	TVS Suzuki Ltd, Hosur
Shri K. Pandarinath Shri V. R. Janardhnam (*Alternate*)	Sundaram Abex Ltd, Madras
Shri K. S. Parthasarathy Shri M. V. Venkateswaran (*Alternate*)	Mahindra and Mahindra Ltd, Nasik
Shri V. Ramakrishnan Shri S. M. Iqbal (*Alternate*)	Rane Brake Linings, Madras
Shri S. Ramaswamy	Hindustan Ferodo Ltd, Bombay
Shri K. V. Rami Reddy	Ministry of Surface Transport, New Delhi
Shri I. V. Rao Shri Deepak Sawkar (*Alternate*)	Maruti Udyog Ltd, Gurgaon
Shri Ram Mohan	DCM Toyota Ltd, New Delhi
Shri S. Selvamani Shri M. Panchapakesan (*Alternate*)	Sundaram Clayton Ltd, Madras
Shri Sharad Saxena Shri R. S. Grover (*Alternate*)	Eicher Motors Ltd, Dhar
Shri A. K. Sen Shri N. Karuppaiah (*Alternate*)	Vehicle Research and Development Establishment, Ahmednagar
Shri S. N. Srinivasan Shri V. Murugan (*Alternate*)	Premier Automobiles Ltd, Bombay
Shri S. R. Tapade Shri S. Kumar (*Alternate*)	Central Institute of Road Transport, Pune
Shri V. S. Venkatesan Shri K. N. Balaji (*Alternate*)	Brakes India Ltd, Madras
Shri N. S. Vijayaraghavan Director (Transport Engineering)	Director General, BIS (*Ex-officio Member*)

Member Secretary

Shri M. V. S. D. Prasada Rao
Joint Director (Transport Engineering), BIS

(*Continued on page* 9)

(*Continued from page* 8)

Two and Three Wheelers Braking Systems Subcommittee, TED 4 : 1

Convener	*Representing*
Shri K. C. Jain	Escorts Ltd (MSD), Faridabad
Members	
Shri H. K. Acharya	Enfield India Ltd, Madras
Shri G. Venkataraman (*Alternate*)	
Shri T. M. Balaraman	Bajaj Auto Ltd, Pune
Shri S. B. Gupta	Hero Honda Motors Ltd, Dharuhera
Shri P. R. Rao (*Alternate*)	
Shri J. S. Khadilkar	Kalyani Brakes Ltd, Pune
Shri S. S. Patil (*Alternate*)	
Shri V. R. Marathe	Kinetic Engineers Ltd, Pune
Shri P. V. Bhandre (*Alternate*)	
Shri Z. A. Mujawar	Automotive Research Association of India, Pune
Shri V. M. Mundada	Bajaj Tempo Ltd, Pune
Shri M. N. Muralikrishna	TVS Suzuki Ltd, Hosur
Shri K. Pandarinath	Sundaram Abex Ltd, Madras
Shri K. N. Ravi (*Alternate*)	
Shri K. H. Ramachandrappa	Vehicle Research & Development Establishment, Ahmednagar
Dr C. L. Dhamijani (*Alternate*)	
Shri S. Ramaswamy	Hindustan Ferodo Ltd, Bombay
Shri K. Vijayakumar	Kerala Automobiles Ltd, Trivandrum

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act, 1986* to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Copyright

BIS has the copyright of all its publications. No part of these publications may be reproduced in any form without the prior permission in writing of BIS. This does not preclude the free use, in the course of implementing the standard, of necessary details, such as symbols and sizes, type or grade designations. Enquiries relating to copyright be addressed to the Director (Publications), BIS.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition.

This Indian Standard has been developed from Doc No. TED 4 (3367)

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones : 331 01 31, 331 13 75

Telegrams : Manaksanstha
(Common to all offices)

Regional Offices :		Telephone
Central :	Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	331 01 31 331 13 75
Eastern :	1/14 C. I. T. Scheme VII M, V. I. P. Road, Maniktola CALCUTTA 700054	37 84 99, 37 85 61 37 86 26, 37 86 62
Northern :	SCO 335-336, Sector 34-A, CHANDIGARH 160022	60 38 43 60 20 25
Southern :	C. I. T. Campus, IV Cross Road, MADRAS 600113	235 02 16, 235 04 42 235 15 19, 235 23 15
Western :	Manakalaya, E9 MIDC, Marol, Andheri (East) BOMBAY 400093	632 92 95, 632 78 58 632 78 91, 632 78 92

Branches : AHMADABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. PATNA. THIRUVANANTHAPURAM.

AMENDMENT NO. 1 SEPTEMBER 1997
TO
IS 2742 (PART 4) : 1994 AUTOMOTIVE VEHICLES — BRAKE LININGS

PART 4 COEFFICIENT OF FRICTION — METHOD OF TEST

(*Page* 1, *clause* 4.1.1, *informal table, under Drum Inside Diameter*) — Substitute '277-278' *for* '277-280'.

(*Page* 2, *clause* 6.1, *para* 2, *second sentence*) — Substitute the following for the existing sentence:

'Where width of the lining is less than those specified, actual width of lining shall be considered'.

(TED 4)

Reprography Unit, BIS, New Delhi, India